



# GROUND CONNECTION STRUCTURE, GROUND CONNECTING MEMBER AND GROUND CONNECTION METHOD

## BACKGROUND OF THE INVENTION

### Field of the Invention

- [01] The present invention relates to the structure for connecting a ground on a substrate to a compensating member for compensating for an area of the ground, and relates also to a member and a method for connecting the ground to the compensating member.

### Description of the Related Art

- [02] As a method for restraining the EMI (Electro Magnetic Interference) of electronic units, a method for increasing the area of the ground (the earth) is well known.
- [03] In a technique disclosed in Unexamined Japanese Patent Application KOKAI Publication No. H11-204162, an enlargement ground member for compensating for the area of the ground is fixed into the casing, and a substrate of a circuit and the enlargement ground member are fixed by metal screws, etc. The metal screws are in contact with the ground of the substrate, so as to electrically connect the ground and the enlargement ground member.
- [04] To lower the impedance between the ground and the enlargement ground member, it is necessary to connect the ground and the enlargement ground member at a plurality of points.
- [05] In the case where the metal screws are employed in the above structure, the ground should be connected with the enlargement ground member using the plurality

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of metal screws. According to the technique disclosed in the above publication, other than those screws necessary for fixing the substrate to the enlargement ground member, a large number of metal screws are necessary for lowering the impedance between the ground the enlargement ground member.

- [06] To maintain the electric connection between the ground and the enlargement ground member, bosses which catch the metal screws need to be prepared on the enlargement ground member. That is, in the case where the plurality of metal screws are employed, a plurality of bosses need to be prepared on the enlargement ground member.
- [07] As described above, according to the technique of the above publication, a large number of component parts for connecting the ground of the substrate with the enlargement ground member are required. Hence, the structure for connecting the component parts will inevitably be complicated, and a large number of connection processes are required.
- [08] The entire contents of Unexamined Japanese Patent Application KOKAI Publication No. H11-204162 are incorporated herein by reference in its entirety.

#### SUMMARY OF THE INVENTION

- [09] The present invention has been made in consideration of the above. It is accordingly an object of the present invention to provide the ground connection structure, ground connecting member, ground connection method for easily connecting a ground of a substrate to a compensating member for compensating for the area of the ground.
- [10] In order to attain the above object, according to the first aspect of the present invention, there is provided a ground connection structure comprising:
- [11] a substrate, on whose surface a ground is formed;

- [12] a ground connecting member which is connected to the ground; and
  - [13] a compensating member which compensates for an area of the ground and is joined to the substrate such that the ground connecting member is sandwiched between the compensating member and the substrate, and
  - [14] wherein the ground connecting member has elasticity, contacts the compensating member by being sandwiched between the substrate and the compensating member, and electrically connects the ground with the compensating member in a low impedance state.
- [15] According to this structure, the ground of a substrate and a compensating member for compensating for the area of the ground can easily be connected with each other.
- [16] The ground connecting member may comprise:
  - [17] a base which is connected to the ground; and
  - [18] a spacer which is arranged on the base and has elasticity.
- [19] The substrate may have at least one through-hole for fixing the ground connecting member on the substrate; and
- [20] the base may include at least one lead, which is inserted into the at least one through-hole and connected to the ground.
- [21] The at least one lead may have elasticity and a protruding portion for fixing the ground connecting member onto the substrate.
- [22] The base may have at least one lead having a margin, left for being connected to the ground and formed in parallel with a surface of the ground.
- [23] The spacer may include a plate spring.
- [24] The spacer may include a coil spring.

- [25] In order to attain the above object, according to the second aspect of the present invention, there is provided an ground connecting member, which is arranged between a substrate and a compensating member which compensates for an area of ground formed on the substrate, and which electrically connects the ground and the compensating member, and the ground connecting member comprising:
- [26] a base which is connected to the ground; and
- [27] a spacer which is arranged on the base and has elasticity, and
- [28] wherein the spacer is in contact with the compensating member, in a state where the ground connecting member is sandwiched between the substrate and the compensating member, and electrically connects the ground and the compensating member in a low impedance state.
- [29] The substrate may have at least one through-hole for fixing the ground connecting member onto the substrate;
- [30] the base may have at least one lead to be inserted into the at least one through-hole; and
- [31] the at least one lead may have elasticity and a protruding portion for fixing the ground connecting member onto the substrate.
- [32] The base may have at least one lead having a margin, left for being connected to the ground and being in parallel with a surface of the ground.
- [33] The spacer may include a plate spring.
- [34] The spacer may include a coil spring.
- [35] In order to attain the above object, according to the third aspect of the present invention, there is provided a ground connection method comprising:
- [36] connecting an ground connecting member having elasticity and conductivity, to ground formed on a substrate; and

[37] arranging a compensating member for compensating for an area of the ground, on the substrate such that the ground connecting member is sandwiched between the compensating member and the substrate, thereby electrically connecting the ~~earth~~ ground and the compensating member via the ground connecting member in a low impedance state.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[38] These objects and other objects and advantages of the present invention will become more apparent upon reading of the following detailed description and the accompanying drawings in which:

[39] FIG. 1 is a diagram showing the positional relationship of a ground connecting member, an internal substrate and a chassis;

[40] FIG. 2 is a cross sectional view showing a state, in which the internal substrate on which the ground connecting member is mounted is fixed onto the chassis;

[41] FIG. 3 is a diagram showing the structure of a ground connecting member according to the first embodiment of the present invention;

[42] FIG. 4 is a diagram showing a method for fixing the ground connecting member onto the internal substrate;

[43] FIG. 5 is a diagram showing a method for fixing a ground connecting member, according to the second embodiment of the present invention, onto an internal substrate;

[44] FIG. 6 is a diagram showing the structure of the ground connecting member according to the second embodiment;

[45] FIG. 7 is a diagram showing another structure of the ground connecting member according to the first embodiment of the present invention;

- [46] FIG. 8 is a diagram showing a state wherein a plurality of ground connecting members are fixed onto the same internal substrate; and
- [47] FIGS. 9A to 9C are diagrams showing various shapes of a metal spacer included in the ground connecting member.

**DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS**

- [48] A ground connecting member according to the first embodiment of the present invention will now be described with reference to the accompanying drawings.
- [49] The ground connecting member of the first embodiment electrically connects a ground wiring formed on the internal substrate of an electronic unit with a chassis used as a compensating member for compensating for the area of the ground.
- [50] FIG. 1 is a diagram showing the positional relationship of a ground connecting member 1, an internal substrate 2 and a chassis 4.
- [51] As shown in FIG. 1, the ground connecting member 1 is installed on the back surface of the internal substrate 2, and connected to the ground wiring 3 formed on the front surface of the internal substrate 2. The ground connecting member 1 is sandwiched between the internal surface 2 and the chassis 4, thereby electrically connecting the ground wiring 3 and the chassis 4.
- [52] The internal substrate 2 has a plurality of through-holes 7 for fixing the ground connecting member 1 on the internal substrate 2 and a screw hole 8 through which a screw 6 for fixing the internal substrate 2 on the chassis 4 passes.
- [53] The plurality of through-holes 7 are formed in such positions that the ground connecting member 1 can be soldered on the ground wiring 3 so as to be connected thereto.
- [54] Various electronic units (not illustrated) are mounted on the surface of the internal substrate 2.

- [55] The chassis 4 is made of metal having conductivity, and has a boss 5 into which the screw 6 is inserted.
- [56] The internal substrate 2 is fixed on the chassis 4, if the screw 6 is inserted into the boss 5, through the screw hole 8. In this structure, as shown in FIG. 2, the ground connecting member 1 is sandwiched between the internal substrate 2 and the chassis 4.
- [57] Note that only one boss 5, one screw 6 and one screw hole 8 are shown in FIG. 1. However, a plurality of bosses 5, a plurality of screws 6 and a plurality of screw holes 8 may be prepared, if they are necessary for fixing the internal substrate 2 onto the chassis 4.
- [58] The structure of the ground connecting member 1 will now specifically be described.
- [59] As shown in FIG. 3, the ground connecting member 1 comprises a base section 10 and a metal spacer 11.
- [60] The base section 10 has a plurality of leads 12 to be inserted into the respective through-holes 7. The leads 12 are inserted into the respective through holes 7 from the back surface of the internal substrate 2, as illustrated in FIG. 4, and then soldered on the ground wiring 3. Thus, the base section 10 (at least the leads 12 included therein) are formed from materials (e.g. copper, tin, etc.) which have conductivity and which can easily be adhered to solder.
- [61] The metal spacer 11 is connected to the base section 10 using a connection method (e.g. spot welding, etc.) to obtain a desired level of conductivity. The metal spacer 11 is formed of conductive metal having elasticity. Particularly, a plate spring formed of copper, aluminum, or the like may be used as the metal spacer 11. Then,

the metal spacer 11 repels the pressure which is applied by the internal substrate 2 and the chassis 4, and is adhered onto the surface of the chassis 4.

[62] The pressure applied onto the metal spacer 11 can be adjusted, by adjusting the distance (the clearance “B” shown in FIG. 2) between the chassis 4 and the base section 10. That is, the narrower the clearance “B” is, the more the pressure is applied to the metal spacer 11.

[63] Accordingly, the metal spacer 11 of the ground connecting member 1 gets smaller upon application of pressure from the internal substrate 2 and the chassis 4, thereby the electric connection between the ground wiring 3 and the chassis 4 can reliably be obtained. The metal spacer 11 is pressed against and directly connected to the chassis 4. Hence, in this structure, the ground wiring 3 and the chassis 4 are connected with each other in a low impedance state. In other words, the earth ground wiring 3 and the chassis 4 can be connected in a low impedance state in the simple structure and using an easy connection method, and hence resulting in a high effect of restraining noises from occurring in the electronic unit.

[64] A ground connecting member according to the second embodiment of the present invention will now be described with reference to the accompanying drawings.

[65] The ground connecting member of the second embodiment, like the case of the first embodiment, electrically connects the ground wiring formed on the internal substrate with the chassis used as a compensating member for compensating for the area of the ground.

[66] Note, however, that the structure of the ground connecting member and a method for fixing the ground connecting member onto the internal substrate are different from those of the first embodiment.

- [67] As shown in FIG. 5, the internal substrate 2 has an exposure windows 9 for exposing the ground wiring 3, formed on the front surface of the internal substrate 2, to the back surface of the internal substrate 2. A ground connecting member 21 is soldered to an exposing portion of the ground wiring 3, from the back surface of the internal substrate 2.
- [68] FIG. 6 is a diagram showing the structure of the ground connecting member 21.
- [69] The ground connecting member 21 comprises a base section 22 and a metal spacer 23, as illustrated in FIG. 6.
- [70] The base section 22 has a plurality of leads 24 which are soldered onto the ground wiring 3. Each of the plurality of leads 24 is wider than each of the leads 12 described in the first embodiment, and is bent as illustrated in FIG. 6. A tip part 24A from the bent portion of each lead 24 is parallel to the surface of the ground wiring 3, and is used as a margin left for soldering the lead 24 to the ground wiring 3. Hence, the connection area of the lead 24 and the ground wiring 3 is large. In this structure, the lead 24 can reliably be soldered to the ground wiring 3, even when no through-hole 7 described in the first embodiment is prepared in the internal substrate 2.
- [71] The base section 22 is soldered to the ground wiring 3. Thus, like the first embodiment, the base section 22 (at least the lead 24) is formed from a material (e.g. copper, tin, etc.) which has conductivity and which can easily be adhered to solder.
- [72] The metal spacer 23 is substantially the same as the metal spacer 11 described in the first embodiment.
- [73] The ground connecting member 21 fixed on the internal substrate 2 is sandwiched between the internal substrate 2 and the chassis 4, like the first

embodiment. Hence, in this structure, the ground connecting member 21 is pressed against and connected to the surface of the chassis 4.

[74] Accordingly, the ground connecting member 21 is sandwiched between the internal substrate 2 and the chassis 4, thereby reliably connecting the ground wiring 3 and the chassis 4. Because the metal spacer 23 is pressed against and directly connected to the chassis 4, the ground wiring 3 and the chassis 4 are connected with each other in a low impedance state. In other words, the ground wiring 3 and the chassis 4 can be connected with each other in a low impedance state in the simple structure of the ground connecting member and using an easy connection method, and hence resulting in a high effect of restraining noises from occurring in the electronic unit.

[75] The ground connecting member 1 described in the first embodiment may include a base section 30 shown in FIG. 7. The base section 30 has a plurality of leads 31 to be inserted into the through-holes 7. Each of the leads 31 is formed of a conductive material (e.g. copper, etc.), which has elasticity. As illustrated in FIG. 7, each of the leads 31 has a protruding portion 31A for fixing the ground connecting member 1 onto the internal substrate 2. As described above, each of the leads 31 is formed of conductive material having elasticity. Thus, the ground connecting member 1 can be fixed on the internal substrate 2 and the ground connecting member 1 can be connected to the ground wiring 3 only by inserting the leads 31 into the through-holes 7, without soldering the ground connecting member 1 to the ground wiring 3.

[76] As described in FIG. 8, a plurality of ground connecting members 1 and 21 may be fixed on the same internal substrate 2. In this structure, the ground wiring 3 and the chassis 4 can electrically be connected at a plurality of points, and hence

realizing a state where the impedance is lower than the cases of the first and second embodiments.

[77] The cross section of the metal spacers 11 and 23 may be any form other than the triangle-like shape of the above-described first and second embodiments. For example, the cross section of the metal spacers 11 and 23 may be circular shown in FIG. 9A or may be a “Z”-like shape shown in FIG. 9B. Even in this case, the same effect as the above embodiments can be obtained. Note that if the cross section of the metal spacers 11 and 23 is the “Z”-like shape, the connection area between the metal spacers 11 and 23 and the chassis 4 is larger than the case where the cross section of the metal spacers 11 and 23 is triangular or circular, and hence realizing a state where the impedance is lower than the case where the cross section thereof is triangular or circular.

[78] Each of the metal spacers 11 and 23 may be a coil spring, etc. as shown in FIG. 9C. Even in this structure, the same effect as that of the above embodiments can be obtained.

[79] Various embodiments and changes may be made thereonto without departing from the broad spirit and scope of the invention. The above-described embodiments are intended to illustrate the present invention, not to limit the scope of the present invention. The scope of the present invention is shown by the attached claims rather than the embodiments. Various modifications made within the meaning of an equivalent of the claims of the invention and within the claims are to be regarded to be in the scope of the present invention.

[80] This application is based on Japanese Patent Application No. 2001-012470 filed on January 19, 2001, and including specification, claims, drawings and

summary. The disclosure of the above Japanese Patent Application is incorporated herein by reference in its entirety.